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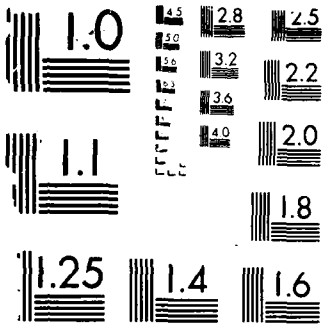

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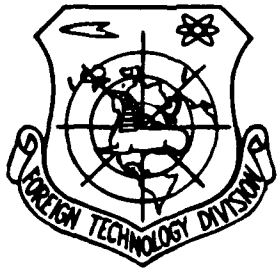
FOREIGN TECHNOLOGY DIVISION

REACTION OF LITHIUM WITH TITANIUM AT ELEVATED TEMPERATURES

by

A.I. Pekarev, Ye. M. Savitskiy, M.A. Tylkina



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FTD-ID(RS)T-0357-87 5 June 1987

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By: A.I. Pekarev, Ye. M. Savitskiy, M.A. Tylkina

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> In them occurs the state named "night blindness" - hemeralopia, which, according to the current point of view, is a result of damage of the rod-shaped apparatus of the eye.
>
> Page 51.
>
> However, in recent years it has been shown that with the hereditary pigment degenerations in animals the biochemical changes are observed in all celluar elements of the retina.

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Block	Italic	Transliteration	Block	Italic	Transliteration
А а	*А а*	A, a	Р р	*Р р*	R, r
Б б	*Б б*	B, b	С с	*С с*	S, s
В в	*В в*	V, v	Т т	*Т т*	T, t
Г г	*Г г*	G, g	У у	*У у*	U, u
Д д	*Д д*	D, d	Ф ф	*Ф ф*	F, f
Е е	*Е е*	Ye, ye; E, e*	Х х	*Х х*	Kh, kh
Ж ж	*Ж ж*	Zh, zh	Ц ц	*Ц ц*	Ts, ts
З з	*З з*	Z, z	Ч ч	*Ч ч*	Ch, ch
И и	*И и*	I, i	Ш ш	*Ш ш*	Sh, sh
Й й	*Й й*	Y, y	Щ щ	*Щ щ*	Shch, shch
К к	*К к*	K, k	Ъ ъ	*Ъ ъ*	"
Л л	*Л л*	L, l	Ы ы	*Ы ы*	Y, y
М м	*М м*	M, m	Ь ь	*Ь ь*	'
Н н	*Н н*	N, n	Э э	*Э э*	E, e
О о	*О о*	O, o	Ю ю	*Ю ю*	Yu, yu
П п	*П п*	P, p	Я я	*Я я*	Ya, ya

*ye initially, after vowels, and after ъ, ь; e elsewhere.
When written as ё in Russian, transliterate as yё or ё.

RUSSIAN AND ENGLISH TRIGONOMETRIC FUNCTIONS

Russian	English	Russian	English	Russian	English
sin	sin	sh	sinh	arc sh	$\sinh^{-1}$
cos	cos	ch	cosh	arc ch	$\cosh^{-1}$
tg	tan	th	tanh	arc th	$\tanh^{-1}$
ctg	cot	cth	coth	arc cth	$\coth^{-1}$
sec	sec	sch	sech	arc sch	sech^{-1}
cosec	csc	csch	csch	arc csch	csch^{-1}

Russian	English
rot	curl
lg	log

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REACTION OF LITHIUM WITH TITANIUM AT ELEVATED TEMPERATURES.

A. I. Pekarev, Ye. M. Savitskiy, M. A. Tylkina.

In some installations as heat carriers are used liquid low-melting metal - lithium, sodium, potassium, etc. [1]. Therefore study of character of reaction of liquid-metal heat carrier with materials of fittings - by tubes/pipes, heat exchangers, closures - acquires at present high importance.

In this work reaction of lithium with titanium in range of temperatures of 300-1300° in presence of small quantities of nitrogen and oxygen was investigated.

In the literature has information about limited durability of titanium in liquid lithium [1] and about temperature dependence of solubility of lithium in zirconium [2], and also about formation of solid compounds on surface if zirconium in presence of nitrogen.

Diagram of system titanium - lithium is not constructed. Is known the existence of the ternary compounds Li_4TiO_4 and Li_4TiN_4, and also the similar compounds with arsenic and phosphorus [3].

By us as initial materials they were undertaken: metallic lithium by purity/finish 99.88% and iodide titanium by purity/finish

99.8%.

For explaining character of reaction of lithium with iodide titanium procedure, similar to that described in works [4, 5] for construction of constitution diagrams of systems Ti-Mg and Ti-Ca was used.

Fig. 1 shows fitting for surface saturation by liquid lithium of titanium. Container 1, grooved from the rod of iodide titanium, after the etching of internal surface was filled with fine/small titanate shaving 2 and was packed by the freshly-cut small pieces of metallic lithium 3, and then it was tightly bolted up by titanate cork/stopper 4. Titanate container was placed into steel container 5, which was upward charged by finely pulverized sponge titanium 6. The upper part of the container during several minutes was blown out/blown off by the stream of argon, and container was bolted up by steel cork/stopper 7 (thread it were preliminarily covered/coated with the layer of graphite lubrication).

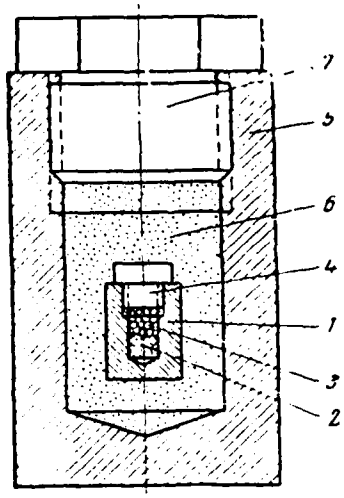

Fig. 1. Steel and titanate containers. Lithium is placed into the titanate container.

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Container was maintained/withstood in box furnace at constant temperature for several hours. Temperature let us lie holding they are given in the table.

Each titanate container and shaving were used only for one temperature. After heating and cooling in the water steel corks/stoppers were unscrewed. The steel containers, sustained at temperatures 1150 and 1300°, were cut, since thread was welded. All titanate containers had the bright unoxidized surface. In all containers was kept the excess of lithium, which did not enter the reaction and which did not filter through the microcracks between the crystals of titanium.

Opened titanate containers and separately shaving, extracted of them, thoroughly were washed in boiling distilled water for dissolution of excess of lithium.

By spectral method is determined [1] approximate content of lithium, dissolved in titanate shaving (see table).

FOOTNOTE [1]. The determination of lithium in titanium by the methods of flame photometric and spectral analysis was conducted in analytical laboratory of IMET [IMET - Institute of Metallurgy im. A. A. Baykov] by I. A. Golubeva and M. V. Nikitina. ENDFOOTNOTE.

As the standards for the spectral analysis of lithium in titanate shavings were used the samples of titanium with different low content of lithium (from 0.002 to 0.12 weights % Li) and they were subjected to the flame photometric analysis, which has sensitivity 0.0001% Li.

Dependence of solubility of lithium in titanium on temperature for time indicated is represented graphically in Fig. 2. As can be seen from graph, the solubility of lithium in titanium is increased with an increase in the temperature, reaching maximum value of approximately 1050°. With further increase in the temperature the solubility of lithium sharply falls, which is connected, obviously, with the polymorphic transformation of titanium. A similar character of the dependence of the solubility of calcium in titanium is obtained by Obinata et al [5].

Solubility of lithium in titanium at elevated temperatures.

(1) Номер контейнера	(2) Температура, °С	(3) Время выдержки, час	(4) Содержание лития, вес. % (не более)
1	300	14	0,005
2	500	8	0,001
3	800	5	0,01
4	950	4	0,1
5	1050	4	0,2
6	1150	3	0,001
7	1300	1	0,001

Key: (1). Number of container. (2). Temperature, °C. (3). Holding time, hour. (4). Content of lithium, weight % (not more).

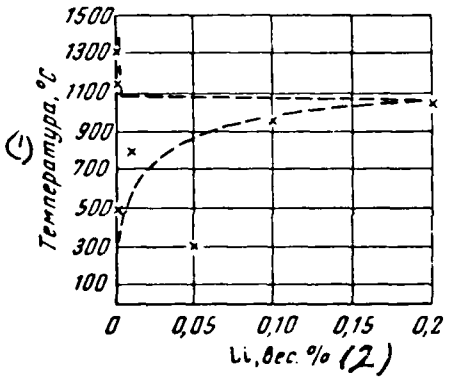

Fig. 2. Solubility of lithium in titanate shaving at elevated temperatures.

Key: (1). Temperature, °C. (2). Weight, %.

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X-ray structural investigation of titanate shaving during photographings during copper emission in Debye's chamber/camera did not reveal/detect changes in lattice parameter of α-titanium.

Titanate containers, cut by grinding wheel along axis/axle,

underwent metallographic examination. After polishing the ground joints were etched in aqueous solution 5% HNO_3 and 5% HF. On the internal edge and in the microcracks of the ground joints of the containers, sustained with 800, 950 and 1050° in the contact with liquid lithium, clearly distinguished (Fig. 3) the bright unetched strip, which is expanded in the direction of thread from 20 to 60 μ. An increase of the thickness of surface layer in the direction of thread is connected, obviously, with the entry through the gaps in the thread of small quantities of oxygen and nitrogen.

Microhardness of surface layer with load 25 g is equal to 1100 kgf/mm^2.

Besides formation of surface brittle layer, liquid lithium at elevated temperatures also penetrates on boundaries of grains of titanium (Fig. 3a, b).

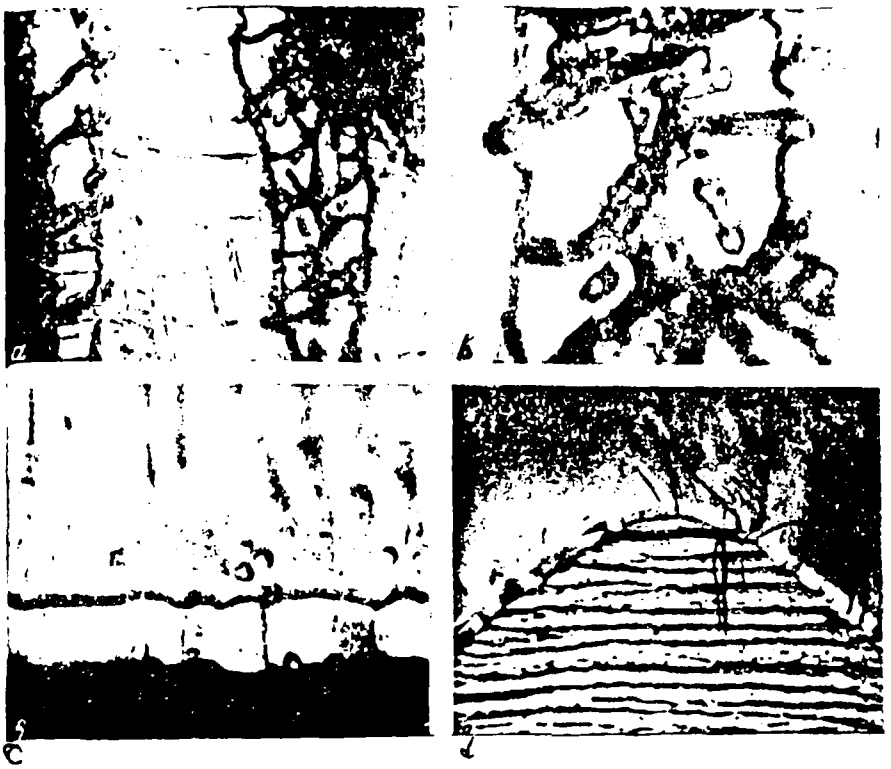

Fig. 3. Microstructure of longitudinal section of titanate container (holding with lithium at 1050° during 4 hour). a - intercrystalline and surface corrosion, ×200; b - the same, ×600; c - brittle surface layer from the internal surface of container, ×600; d - surface layer on the thread, ×250.

CONCLUSIONS.

By diffusion saturation of internal surface of titanate container and titanate shaving by liquid lithium was studied reaction of lithium with iodide titanium in range of temperatures of 300-1300°. The solubility of liquid lithium in titanium is increased to temperature of 1050°, and then sharply is decreased, which is connected with the polymorphic transformation of titanium.

It is established that with increase in temperature corrosion effect of lithium on titanium by intercrystalline penetration of liquid lithium with formation on surface of titanium of thin layer, which possesses high hardness (1000 kgf/mm²) and brittleness is reinforced. Corrosion is developed especially strongly in the presence of small quantities of oxygen and nitrogen.

REFERENCES,

1. П. А. Андреев. Жидкометаллические теплоносители ядерных реакторов. Судпромгиз, 1959.
2. Ю. Ф. Бычков, А. Н. Розанов, В. Б. Яковлев. Атомная энергия, 7, вып. 6, 1959.
3. V. R. Jusa, H. H. Weber, E. Meyer—Simoñ. Z. añorgañ. u. allgem. Chem. 273, 48, 1954.
4. I. Obinata, Y. Takeuchi, R. Kawanishi. Metall, N 5, 1959.
5. I. Obinata, Y. Takeuchi, S. Saikawa. Trans. Amer. Soc. Metals, 52, 157, 1959.

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